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Fluorescence microbeam computed tomography of Sr-doped, sector zoned calcite
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Beamline(s): X26A

Introduction: In the past several months beamline X26A has instituted a new analytical program in fluorescence x-ray computed microtomography. This technique allows us to visualize the trace element composition of materials in three dimensions without the need for sectioning of the sample. In many ways this can be considered analogous to a *chemical CAT scan*.

Methods and Materials: In the fluorescence microtomography technique a ca. 10 μm focused monochromatic beam (using Kirckpatrick Baez focusing optics) is scanned through a sample perpendicular to direction of the incident x-ray beam. The energy dispersive fluorescence generated by the interaction of the beam with the material is detected using a Canberra Si(Li) solid state detector. After each line scan, the sample is rotated by a small angle and the scanning is repeated for either 180° or 360° of rotation to construct a fluorescence sinogram (fluorescence intensity as a function of horizontal distance vs. angle). These sinograms can then be back projected using classical tomographic techniques to reconstruct the elemental distribution through the sample, as in a medical CAT scan. The procedure can be repeated vertically to reconstruct a three dimensional volume.

Results: As an example of the applications of this technique, the figures below show data from the fluorescence tomography of a Sr doped, sector zoned calcite crystal. Figure 1 is a photo of the analyzed crystal with lines marking the positions of the horizontal scans. Figure 2 is a sonogram of the Sr fluorescence for a slice through the top of the crystal, and Figure 3 is the reconstructed projection for slice 1.

Conclusions: Microbeam fluorescence tomography is a natural extension of compositional analysis already done at the beamline. Particularly for low density samples such as plant materials, this provides a unique method to image metal distributions without sectioning.

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